

XIII.—On the Division of *Ctenobranchous Gasteropodous Mollusca* into larger Groups and Families. By J. E. GRAY, Ph.D., F.R.S., V.P.Z.S. &c.

CUVIER, Dumeril, and Lamarck separated the Gasteropodous Mollusca, which have pectinated or comb-like gills, into two divisions, according as they possessed or were without a siphon to facilitate the admission of water to their gills, probably being influenced by preceding conchologists, who had in a similar manner divided the spiral shells into those which had an entire, or an emarginated, or a channelled mouth. Lamarck called those with a siphon *Zoophaga*, and those without it *Phytophaga*, believing the food of the molluscs to be indicated by the form of the mantle. As we have become more acquainted with the habits of the Mollusca, it has been observed that many of the animals without any siphon to the mantle, as *Natica*, *Scalaria*, *Ianthina*, &c., are quite as carnivorous as those which have the siphon most perfectly developed; on the other hand, Lamarck found it requisite to arrange many genera, as *Cerithium*, *Melanopsis*, *Planaxis*, &c., with the *Phytophaga* with entire mouths, though the animals have as well-developed siphons and the shells as distinct canal or siphonal notch, as any of the genera of Zoophagous Mollusca. These divisions, however, have been almost universally adopted. Dr. Lovén in his paper on the Scandinavian Mollusca and on the Tongues of these animals, divided the Gasteropoda into natural families independent of these divisions, and Dr. Troschel in his arrangement of Mollusca has followed the same course, separating the families into groups according to the structure of their tongues. The observations which Dr. Troschel made on the arrangement which I published in Mrs. Gray's work, 'Figures of Molluscous Animals,' have induced me to reconsider the subject, consult again all the authorities, and examine the tongues of the molluscous animals which have been lately received at the Museum collections.

Being impressed with the importance which Dr. Lovén attached to the form of the mouth, I was induced to pay attention to this character, and I believe that it affords a much more natural one to separate families into two great groups, than the presence or the absence of the siphon of the mantle, and one which appears to be more consistent with the habits of the animal and much less liable to exceptions. I may observe in passing that some of the French zoologists do not appear to have been impressed with its importance, for MM. Quoy and Gaimard in some few instances erroneously represent some of the species of a genus, as a *Murex* and *Terebra*, for example, as having a

rostrum, while the greater part of the species are properly represented without it, and as having a proboscis, and the same may be remarked of some of the more modern figures of these animals.

I fully expect that many naturalists, especially those who have chiefly confined their studies to the external form of shell or to the fossil species, will consider that the system here proposed is very artificial, as it separates many genera and families from one another which they have regarded as being very nearly allied, or as belonging to the same family or even genus. But it must be recollected that this was the case when first the study of the animal was undertaken, yet no one now objects to the terrestrial *Helices* and *Bulimi* being separated from the sea shells which were formerly arranged with them, or the *Bullæ* from the other marine families, and we must expect that as the structure of the animal becomes more known, the more the genera founded only on the shells will become separated and dispersed.

In drawing up the characters of the suborders and families, I have attempted to select those which appeared most permanent, or least subject to variation. In all animals, as a general rule, those organs by which they obtain their food belong to the first class; hence the characters of the suborder and its divisions have been taken from the form of the mouth and the disposition and form of the teeth on the lingual membrane, as I have no doubt these parts have a most important bearing on the œconomy of the animal; while the characters of the families have been taken from the modifications of the mantle and differences in the structure and form of the operculum and shell; for though I consider that the characters of the order, suborder, and families should be chiefly taken from modifications of the animal, I always consider that the shell and operculum are quite as important as regards the genus, as the animal which forms it.

Suborder I. PROBOSCIDIFERA. Head small, with an elongated, retractile, longly exsertile proboscis, when retracted hidden within the body; tentacles close together at the base or united by a veil over the base of the proboscis; eyes sessile, on the outer base of the tentacles; operculum annular (except in *Natica*). Carnivorous, eating living mollusca and other animals.

The trunk or proboscis is of a very complicated structure and furnished with a number of muscles, well described by Cuvier in his anatomy of *Buccinum*, which enable it to be withdrawn into itself like the tentacles of a snail. These animals are said to form the round holes so commonly found on other shells, and the lingual membrane is placed near the apex of the exserted trunk.

Suborder II. **ROSTRIFERA.** Head moderate, with a more or less elongated, produced, contractile, transversely annulated rostrum; tentacles subulate, far apart on the side of the rostrum. Essentially phytophagous; the rostrum is only furnished with contractile muscles, and varies in length and shape; in *Struthiolaria* it is very long and conical subulate, but it is not retractile like those of the former suborder; the rostrum of *Strombi* is also elongated, while in some other families it is short and truncated; but it is always easily known from the retractile proboscis of the former group; the lingual membrane is often very long, extending far into the body of the animal.

The families are the same as those characterized in the 'Figures of Molluscous Animals,' vol. iv. 1850, only placed in different order, to show the characters afforded by the teeth, with some new ones rendered necessary by the examination of the teeth of some genera which had not before been described.

#### Suborder I. **PROBOSCIDIIFERA.**

A. *Hamiglossa.* Teeth on lingual membrane in three series (1 · 1 · 1), the central broad, the lateral versatile (fig. 1).

Fam. 1. **MURICIDÆ.** Lateral teeth flat, with a bent-up process at the end more or less at right angles with the base; siphon of mantle and canal of shell straight; foot simple in front; mantle enclosed.

a. *Muricina.* Operculum ovate; nucleus subapical within the apex; varices of shell developed. *Murex, Trophon.*

b. *Fusina.* Operculum ovate, acute; nucleus apical; varices of shell rudimentary or none. *Pisania, Colus, Cassidulus, Chrysodomus.*

? c. *Pusionellina.* Operculum semiovate; nucleus in middle of the straight inner edge. *Pusionella.* Teeth —?

d. *Rapananina.* Operculum ovate, blunt; nucleus elongate, forming the outer or hinder edge. *Rapana, ?Chorus* and ?*Cuma.*

Fam. 2. **BUCCINIDÆ.** Lateral teeth flat, with a bent-up process at the end more or less at right angles with the base; siphon of mantle and canal of shell recurved; foot simple; mantle enclosed.

a. *Buccinina.* Operculum ovate; nucleus small, near outer front edge. *Buccinum.*

b. *Nassina.* Operculum ovate, acute, nucleus apical.

\* Operculum entire. *Latrunculus, Cominella, Phos.*

\*\* Operculum serrated. *Bullia, Nassa, ?Northia.*

c. *Purpurina*. Operculum oblong; nucleus elongate, forming the long outer edge. *Purpura*, *Concholepas*, *Sistrum*, ? *Magillus*.

It is to be observed that the operculum of these two families offers exactly the same modifications.

*Planaxina*, which have been arranged in this family, have a distinct rostrum and operculum like *Littorina*.

Fam. 3. OLIVIDÆ. Siphon of mantle recurved; foot with a cross groove on each side in front; often enclosing part of the shell; mantle enclosed; operculum small or none.

a. *Olivina*. Pillar of shell plaited in front.

\* Lateral teeth broad ovate. *Strephona*, *Olivella*, *Scaphula*, *Agaronia*.

\*\* Lateral teeth hook-like, narrow. *Ancilla*.

? b. *Harpina*. Pillar of shell smooth. *Harpa*. Teeth — ?

Fam. 4. LAMELLARIADÆ. Lateral teeth simple, curved; mantle very large, covering the shell, with a notch in place of the siphon in front; operculum none. *Lamellaria*, *Coriocella*. The genus *Marsenina* (*proditia*) appears more allied to *Velutinidæ*.

B. *Odontoglossa*. Teeth on lingual membrane in three series (1 · 1 · 1), the central recurved, toothed at the tip, the lateral not versatile (figs. 2, 3).

Fam. 5. FASCIOLARIADÆ. Mantle enclosed; siphon and canal of shell straight; shell with plaits on the front of the pillar; central tooth narrow, small; lateral teeth very broad, linear, with many equal teeth (fig. 2). *Fasciolaria*, *Lagena*.

Fam. 6. TURBINELLIDÆ. Mantle enclosed; siphon and canal of shell straight; shell with plaits on the middle of the pillar; central teeth broad, few-toothed; lateral teeth narrowed, strong, with a single large tooth (fig. 3). *Turbinellus*, *Cynodonta*.

C. *Rachiglossa*. Teeth on lingual membrane in a single central series, often toothed (figs. 4, 5).

Fam. 7. VOLUTIDÆ. Shell with plaits on columella; siphon recurved, and canal very short.

a. *Volutina*. Siphon with auricles on side of base; tentacles far apart, united by a broad veil over the head.

\* Teeth lunate, apex 3-toothed (fig. 4). *Yetus*, *Cymbium*, ? *Voluta*.

\*\* Teeth linear, base angularly diverging, with a single conical apex (fig. 5). *Cymbiola*.

b. *Mitrina*. Siphon simple at the base; tentacles close together at the base; mantle enclosed; "teeth broad, many-toothed"? very small at the tip of the proboscis. *Mitra*, *Turris*, *Imbricaria*.

c. *Porcellanina*. Siphon simple at the base; tentacles close together at the base; mantle lobes expanded, covering the shell; teeth —? very small? not to be seen in the only specimen (in bad state) I have been able to examine. *Porcellana*, *Persicula*.

The specimen of *P. glabella* in spirits showed no appearance of the dilatation of the mantle.

D. *Toxoglossa*. Teeth on lingual membrane in two lateral series (1·0·1), elongate, subulate (fig. 6).

Fam. 8. PLEUROTOMIDÆ. Siphon of mantle and canal of shell straight; mantle and shell often with a slit in hinder part of right side.

a. *Pleurotomina*. Operculum ovate, acute; nucleus apical. *Pleurotoma*, *Drillia*.

b. *Clavatulina*. Operculum semiovate; nucleus in the centre of the straight front edge. *Clavatula*, *Tomella*.

c. *Defrancianina*. Operculum none. *Mangelia*, *Defrancia*.

E. *Tænioglossa*. Teeth on lingual membrane in seven rows (3·1·3), central generally toothed, lateral in three series, converging, the inner often broad, two outer subulate, versatile (fig. 7).

Fam. 9. DOLIIDÆ. Foot small; siphon of mantle recurved; mantle enclosed; operculum none. *Dolium*, ? *Malea*. Tongue—?

Fam. 10. TRITONIADÆ. Foot small; siphon of mantle and canal of shell straight; shell variced; mantle enclosed; operculum ovate, annular; nucleus subapical. *Apollon*, *Triton*, *Persona*. The teeth of this family have been verified in a dozen species of the three genera.

Fam. 11. SCYTOTYPIDÆ. Foot small; siphon of mantle produced; operculum none. *Scytotypus*\*.

Fam. 12. VELUTINIDÆ. Foot moderate, rounded; mantle edge inflated, folded on the edge into two canals; eyes on outer side of tentacles. Operculum none. *Velutina*, *Otina*, ? *Marsenina*.

Fam. 13. NATICIDÆ. Foot very large, much produced; shell

\* In Ann. and Mag. Nat. Hist. x. 415. 1852, by a slip of the pen, I erroneously stated that this animal had no proboscis.

sunk into the foot ; eyes none ; operculum distinct, spiral, few-whorled (fig. 7).

a. Operculum, outer layer shelly. *Natica*.

b. Operculum simple, horny. *Neverita*, *Polinices*, *Mammilla*, *Stomatia*.

From Dr. Lovén's description of the animal of *Trichotropis borealis*, it should be referred to this suborder, and equally so by Messrs. Forbes and Hanley's figures, t. II. f. 1 ; but in examining the animals of *Trichotropis bicarinatus*, the original type of the genus, I find the animal to have a rostrum and no proboscis. I should have been inclined to have regarded the animal of these two species as probably forming two genera, but Messrs. Forbes and Hanley's description of the animal (Brit. Moll. 361) agrees pretty well with the animal of *T. bicarinatus*.

F. Ptenoglossa. *Teeth on lingual membrane in many series, numerous, similar* (fig. 8).

Fam. 14. CASSIDIDÆ. Mantle enclosed, with a recurved siphon ; shell ventricose, subglobose, with a recurved canal, often variced ; outer lip thickened ; lingual membrane short, broad, triangular, with many rows of similar lancet-shaped teeth, and a single small dentated tooth in the central series ; operculum annular ; nucleus in the middle of the straight inner side. *Bezoardica*, ?*Cassis*, ?*Levenia*, ?*Morio*. The teeth bear no resemblance to those figured by Quoy and Gaimard as those of *Bezoardica*.

Fam. 15. SCALARIADÆ. Foot moderate, mantle enclosed ; shell turritid, variced, without any canal ; eyes on outer side of the subulate tentacles ; operculum horny, spiral. *Scalaria*.

Fam. 16. ACTEONIDÆ. Foot moderate ; mantle enclosed ; eyes on the inner side of the base of the expanded tentacles ; operculum horny, subspiral. *Acteon*.

G. Gymnoglossa. *Teeth and lingual membrane rudimentary or none*.

Fam. 17. ACUSIDÆ. Foot small ; mantle enclosed, with an elongated siphon ; shell turritid ; lip thin, not variced ; eyes on tip of tentacles or wanting ; tentacles very small or wanting ; operculum annular ; nucleus apical. *Acus* (tentacles small). *Subula* (tentacles and eyes none). *Leiodomus* (suture callous ; operculum ovate ; tentacles small ; has been confounded with *Bullia*).

Fam. 18. PYRAMIDELLIDÆ. Foot moderate ; mantle enclosed ; eyes on the inner side of the broad folded tentacles ; operculum horny, spiral ; shell spiral, pillar plaited.

a. *Pyramidellina*. Shell turritid. *Obeliscus*, *Odostomia*, *Eulima*, *Aclis*, ? *Stylina*.

b. *Tylodinina*. Shell subspiral. *Tylodina*.

*Cerithiopsis* of Forbes and Hanley, tab. OO, if accurately described, must form a new family in this section.

Fam. 19. ARCHITECTOMIDÆ. Tentacles folded, with the suture below; eyes sessile on upper surface of their base (*Eydoux*). Gill-cavities divided by a longitudinal fold; foot moderate, truncated in front, rounded behind (*Quoy*). I have not been able to examine the animal of this family, nor has the proboscis been figured, but the position of the tentacles as given by Quoy, and with more detail by Eydoux, lead me to believe that it is furnished with one.

a. Operculum ovate. *Architectoma*.

b. Operculum circular. *Torinia*.

## Suborder II. ROSTRIFERA.

Section 1. Gymnoglossa. *Lingual membrane and teeth none; operculum none.*

Fam. 20. CANCELLARIADÆ. Mantle enclosed; pillar of shell folded; operculum none. *Admete*, ? *Cancellaria*.

Section 2. Toxoglossa. *Lingual membrane with two series of subulate elongate, often barbed, lateral teeth* (fig. 9).

Fam. 21. CONIDÆ. Teeth barbed; mantle enclosed; operculum ovate, nucleus apical. *Conus*.

Section 3. Digitiglossa. *Teeth on lingual membrane in seven rows, 3 · 1 · 3 (or perhaps five rows, 2 · 1 · 2?), the central teeth triangular, recurved, 3-toothed; lateral teeth converging, inner conical, recurved; the outer large, broad, ovate, with numerous long, linear, equal, curved digitations on the upper edge* (fig. 10).

Fam. 22. AMPHIPERASIDÆ. Operculum none; mantle lobes expanded, covering the shell, bearded externally; shell, edge of outer lip inflexed. *Amphiperas*.

The black colour on *A. ovum* washes off when in spirits.

Section 4. Tæniglossa. *Lingual membrane with seven series of teeth (3 · 1 · 3), the central broad, the lateral converging, the inner often broader; outer lateral conical, except in Viviparidæ* (fig. 7).

A. Operculum subannular or none; mantle furnished with a siphon, and shell with a canal in front.

\* *Eyes sessile, on the outer side of the base of the tentacles.*

Fam. 23. CYPREADÆ. Operculum none; mantle lobes ex-

panded, covering the shell; outer lateral teeth conical, entire or toothed. *Cypræa*, *Trivia*, ? *Erato*.

Fam. 24. PEDICULARIADÆ. Operculum none; mantle enclosed. *Pedicularia*.

Fam. 25. APORRHAIIDÆ. Operculum annular, ovate, nucleus apical, small; mantle, outer edge expanded, lobed, or rarely reflexed; siphon and canal of shell bent to the right. *Aporrhais*; *Trichotropis*, lingual membrane short, broad; ? *Struthiolaria*.

(See observations on *Trichotropis* at p. 129.)

\*\* *Eyes on elongated peduncles.*

Fam. 26. STROMBIDÆ. Foot compressed, used for jumping, not walking; mantle, outer side generally expanded and often lobed; muzzle longly conical.

a. *Strombina*. Tentacles on middle of eye-pedicle; operculum claw-like. *Strombus*, *Pterocera*, *Fusus*.

b. *Seraphina*. Tentacles none?, operculum none. *Seraphys*.

B. *Operculum subannular; mantle and shell simple in front; eyes sessile.*

Fam. 27. PHORIDÆ. Foot compressed, used for jumping, not walking; eyes sessile, on the outer side of the subulate tentacles; operculum large, horny, subannular; muzzle conical, produced; tongue —?; teeth —? *Phorus*, *Onustus*.

C. *Operculum annular, regular; mantle with a siphon in front; shell simple in front; eyes produced near the outer side of the base of the subulate tentacles.* *peduncle*

Fam. 28. AMPULLARIADÆ. Central teeth acute, lateral, subulate. *Ampullaria*, *Marissa*, *Pomus*, *Pomella*, *Lanistes*, *Asolene*.

D. *Operculum annular, regular; mantle and shell simple in front; eyes sessile, on the outer side of the base of the subulate tentacles.*

Fam. 29. VIVIPARIDÆ. Teeth abnormal, laminar, longitudinal, ovate; apex recurved, toothed on each side the tip; inner lateral tooth broad. *Viviparus*, *Paludomus*, *Bithinia*.

E. *Operculum annular, regular, with an internal process; mantle and shell simple in front; eyes sessile, far back behind the tentacles.*

Fam. 30. RISSOELLIDÆ. Rostrum divided into two tentacular lobes in front; "teeth in five series," *Alder*. *Rissoella* = *Jeffreysia*, *Alder*; *Rissoina*.



F. *Operculum spiral (rarely wanting)*; mantle and shell generally simple, sometimes with a rudimentary siphon and a canal in front of shell; eyes sessile; outer lateral teeth conical, curved.

a. *Eyes sessile, on outer side of tentacles.*

\* *Gill enclosed, in one or three lines on inner side of mantle-cavity.*

Fam. 31. LITTORINIDÆ. Mantle edge simple or with only a slight fold in front; gills in two series; shell free; foot flat. *Assiminia, Littorina, &c.*

Fam. 32. PLANAXIDÆ. Mantle edge with a siphon and shell with a notch in front. *Planaxis, Quoyia, ? Litiopa.*

Fam. 33. MELANIADÆ. Mantle edge torn, with a more or less distinct siphon in front; gill of a single series of plates. *Rissoa, Skenea, Melania, Vibex, Faunus, Melanatria, Rhinoclavis, Cerithium, Telescopium, Triphoris, Terebellum.*

Fam. 34. VERMETIDÆ. Shell attached, irregular; foot scarcely fit for walking, dilated, clavate at the end. *Vermetus, Serpuloides, Siliquaria, &c.*

Fam. 35. ? VANICOROIDÆ. Shell free; foot small, circular, produced in front with a dilated membranous expansion on each side; operculum horny, ovate; teeth — ? *Vanicoro.*

\*\* *Gills plumose, exposed; lamina pinnate, spirally twisted.*

Fam. 36. VALVATIDÆ. Operculum orbicular, spiral, many-whorled. *Valvata.*

b. *Eyes sessile, on the head between or rather behind the base of the tentacles.*

Fam. 37. CÆCIDÆ. Shell subcylindrical, arched; apex deciduous, subspiral; operculum circular, horny; foot short; teeth — ? *Cæcum.*

Fam. 38. TRUNCATELLIDÆ. Body and shell spiral; foot very short, roundish; muzzle broadly 2-lobed: walks with its foot and lips; teeth — ? *Truncatella.*

G. *Operculum none; mantle and shell simple in front; gills in an oblique line across the mantle-cavity; lamina elongate, linear, partly exposed; eyes small, on the outer side of the base of the tentacles.*

Fam. 39. CAPULIDÆ. Foot folded on itself. *Capulus, Hipponix, Amalthia.*

Fam. 40. CALYPTRÆIDÆ. Foot expanded. *Crypta, Galerus, Crucibulum, Calyptra, Trochita.*

Fig. 2. *Fasciolaria filamentosa*.

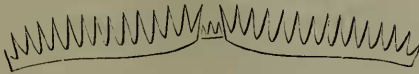


Fig. 8. *Scalaria Turtoni*.

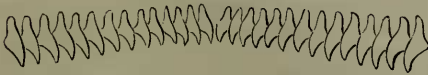


Fig. 4. *Yetus olla*.

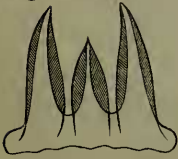


Fig. 5. *Cymbiola Turneri*.



Fig. 6. *Mungelia costata*.



Fig. 9. *Conus* sp.

Fig. 1. *Chrysodomus antiquus*.



Fig. 3. *Turbinellus cornigera*.



Fig. 7. *Natica pulchella*.



Fig. 10. *Amphiperas Ovum*.



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